THE EFFECTS OF ORIENTING TASKS ON THE RECALL AND RECOGNITION MEMORY OF SUBJECTS DIFFERING IN AGE

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SUMMARY

The present experiment was designed to investigate the recall and recognition performance of three adult age groups (20-39 years, 40-59 years, and 60-80 years) following different orienting task requirements. The experiment included three orienting task conditions and a standard "no-orienting-task" condition. In the three orienting task conditions subjects were asked questions concerning the type script (e.g., Is the word printed in capital letters?), or rhyme questions (e.g., Does the word rhyme with TREE?), or category questions (e.g., Is the word a type of fruit?). Subjects in the four task groups were exposed to the same stimulus materials and the same pacing conditions and all subjects were given intentional learning instructions but were not told what type of retention test to expect. Retention was measured with a recognition test for half of the subjects and with a recall test for the remainder of the subjects.

The analysis of the recall data revealed that the young and middle-aged subjects were superior to the oldest subjects under two conditions, the standard "no-orienting-task" condition and the category task condition. Comparisons of the recognition scores for different age groups

within an orienting task condition revealed only one significant difference, that was the difference between the means of young and old subjects in the category condition. Young subjects recognized more words than older subjects did following category questions. The results were discussed in terms of possible age differences in stimulus encoding.

CHAPTER I

INTRODUCTION

In recent years, much of the experimental work on adult age differences in human memory has been carried out within the information-processing framework. The subject is viewed as an active processor with the ability to selectively extract and retain information. Current information-processing models of memory often include three stages: sensory memory, primary or short-term memory, and secondary or long-term memory (e.g., Atkinson and Shiffrin, 1968; Waugh and Norman, 1965).

Information is first extracted and coded by the senses. It is then maintained briefly in a modality-specific sensory memory. When the sense modality is vision, the information is said to be held in "iconic memory" (Neisser, 1967); and when the modality is auditory, the process is labeled "echoic memory" (Crowder & Morton, 1969). The sensory traces are rapidly lost. In order for information to be transfered to primary memory, the subject must attend to the stimuli and rehearse the items. Items in conscious awareness are considered the contents of primary memory. With continued rehearsal and further processing, information is stored in a more permanent secondary memory.

Age Differences in Sensory Memory

Recent reviews of the literature (e.g., Craik, 1977; Walsh, 1975) show that few studies have examined age differences in sensory memory. Researchers have focused on age differences in the retention of information while little attention has been given to the possibility of an age decrement in the capacity to extract information.

Sperling (1960) investigated visual sensory memory in college students in a tachistoscopic recognition experiment. Subjects were exposed to an array of digits or letters and were then asked to recall the items. A tone following the stimulus offset cued the subject to recall one row of the display. Sperling found that performance declined rapidly when the probe was delayed 300-500 milliseconds after stimulus offset. Information loss was attributed to the rapid decay of information from iconic memory.

Abel (1972, cited in Botwinick, 1973) used the Sperling paradigm to examine age differences in iconic memory. The duration of visual display exposure was an extended 500 milliseconds rather than the brief 50 milliseconds used by Sperling. Craik (1977) suggests that Abel's task involved primary memory, and not just sensory memory, for the results with the long exposure time showed relatively little change in performance as the auditory signal delay was varied from 0-300 milliseconds. Significant age differences were found in the number of letters reported from the tachistoscopic arrays, but as the probe was delayed from 0-1200 milliseconds, performance declined similarly in all three adult age groups. For methodological reasons, it is not clear whether Abel's experiment actually involved visual sensory memory. Perhaps the most significant contribution of this study was that it directed others to an important area of research. More recent studies with better controlled procedures have provided some evidence that there is an age decrement in iconic memory (Thompson & Walsh, reported in Walsh, 1975; Schonfield & Wenger, 1975).

Schonfield and Wenger (1975), for example, used a modified staircase method to measure age differences in threshold exposure time for correct identification of a series of letters. One, two, three, four, or five upper case consonants were tachistoscopically presented to subjects in three age groups (20-30 years, 40-50 years, and 60-70 years). There was a dramatic increase in the exposure time required by the oldest subjects to report five letters. The middle-age and young groups demonstrated a much smaller increase. Based on these results Schonfield and Wenger concluded that there is a reduction in perceptual span with age that may be attributed to an age-related sensory memory storage deficit.

Age Differences in Primary Memory

The short-term storage system is distinguished from sensory memories in a number of ways. Commonly accepted differences between the two systems include: a limited capacity for short-term storage but a large capacity for sensory storage (Miller, 1956; Broadbent, 1958); information loss by a process of displacement in short-term storage as opposed to a loss by decay in sensory storage (Waugh & Norman, 1965), and the maintenance of information through continued attention and rehearsal in short-term storage, while it is not possible to maintain information in sensory storage.

Many findings indicate that age decrements in primary or short-term memory are negligible. Using the free recall paradigm, both Craik (1968a) and Raymond (1971) demonstrated that the "recency effect" is similar across adult age groups. When young and old subjects are presented with a list of items and then asked to recall the items in any order, both age groups tend to recall the last few items presented in the list first. These "recent" items are assumed to be held and rehearsed in short-term memory (Glanzer, 1972). The fact that older subjects report items from the recency end of a list as accurately as young subjects suggests that primary memory functioning does not decline with increasing age.

Other investigators have used the immediate memory span technique to examine primary memory functioning. Subjects are presented with strings of digits, letters, or words. The subject's immediate memory span is taken as the number of items in the longest string that is correctly reproduced. Often no age differences are found in memory span performance (e.g., Craik, 1968b; Drachman & Leavitt, 1972). When reliable differences are found, they are slight (e.g., Botwinick & Storandt, 1974; Friedman, 1974).

Bromley (1958) and Botwinick and Storandt (1974) also measured "backward span" performance in subjects differing in age. This task requires the subject to repeat the string of items in reverse order. Age differences in backward span performance are greater than those found with the forward span task as the elderly seem disadvantaged with this modification of the span technique. The backward span task is more demanding of the subject because it requires reorganization of the information maintained in primary memory.

Other techniques have been used to assess age differences in immediate memory (Talland, 1965; Talland, 1968). Talland (1965) compared three different estimates of immediate word span in adults 20 to 69 years of age. In "free recall" subjects were instructed to reproduce all of the words listed in any order. In "selective recall" and "restrictive recall" subjects were presented with a list in which all but one word occurred twice. "Restrictive recall" instructions required subjects to reproduce the entire list in any order, except that the unrepeated word had to be reported last.

No systematic change with age was found in free recall or selective recall, but restrictive recall performance steadily deteriorated with age. In general, when a task involves some reorganization of the material, older subjects do not perform as well as young subjects. However, tasks requiring reorganization may involve secondary memory functioning as well as primary memory functioning.

Age Differences in Secondary Memory

The long-term storage system is distinguished from the short-term store by virtue of its unlimited capacity; by the finding that items are usually coded phonemically in the short-term store but in terms of semantic characteristics in the long-term store (Baddeley, 1966); and by the longer duration of a memory trace in the long-term storage system (minutes to years) (Shiffrin & Atkinson, 1969).

Research has shown that while age differences in primary memory are minimal, age differences in secondary memory or learning are substantial. In the free recall of a supraspan list of words, for example, while older subjects recall as many "recent" words as young subjects, they recall fewer words from the beginning and the middle of the list (Craik, 1968a; Raymond, 1971). Because only a few items can be held in primary memory, the items from the beginning and the middle of any list exceeding the immediate memory span must be stored in, and later retrieved from, secondary memory.

Retrieval

A number of investigators have suggested that older adults do not recall as well as young adults because older individuals have difficulty retrieving information from memory (Craik & Masani, 1969; Laurence, 1967a,b; Schonfield, 1965, 1967; Schonfield & Robertson, 1966). It has been theorized that recall involves two processes, retrieval of the information from memory and then a checking process to determine that the retrieved items are correct (e.g., Kintsch, 1970). In a recognition task the subject is provided with a list of items and must select the correct items by matching the list with information stored in memory. Thus, it is believed that recognition involves a minimal amount of item retrieval.

Comparisons of age differences in recall and recognition performance have provided evidence in support of an age-related retrieval deficit. Schonfield and Robertson (1966) presented young and old subjects with a list of 24 words. All subjects were then given a recall test followed by a recognition test. The recognition test was a forced-choice test with four distractors for each target item. Subjects ranged from 20 to 75 years of age. The results showed a systematic drop in recall scores with age, but no age differences in recognition performance. Schonfield and Robertson concluded that the older subjects had difficulty with the retrieval component of the recall task. Subsequent studies conducted by Craik (1971) and Smith (1975) have replicated this finding. Other studies have found significant age decrements in recognition performance (Botwinick & Storandt, 1974; Erber, 1974; Fozard & Waugh, 1969), but the finding of some age effect in recognition is not inconsistent with the retrieval-deficit hypothesis. The hypothesis simply predicts greater losses in recall than in recognition. The investigations by Harwood and Naylor (1969), Warrington and Silberstein (1970), Warrington and Sanders (1971), and Erber (1974) all reported significant age by retention test interactions with the greatest age differences in recall performance.

Further evidence of an age-related retrieval deficit is provided in the work of Craik (1968b). Craik varied the number of items presented, from five to 20. He also manipulated the size of the category from which the items were selected. The categories were digits, English county names, animals, and unrelated words. Craik found that age differences in recall were greatest when the list was long and when the list items were selected from a large category. Craik suggested that with a shorter list and a limited set of alternatives, the task retrieval demands are small; but with a longer list and a larger pool of items, the elderly are disadvantaged by their inability to retrieve information effectively at the time of recall.

Laurence (1967a) also compared young and old adults in the immediate recall of related and unrelated words. Subjects were either presented with a "single-category" list or a "multiple-category" list. The single-category list consisted of 12 nouns selected from the same category (e.g., animals). In the multiple-category list condition subjects were presented with a list of unrelated words, one noun selected from each of 12 different categories. Laurence found age differences in both conditions of the experiment, but the largest difference was found in the multiple-category list condition. The results can be interpreted in terms of retrieval requirements. A list composed of unrelated words is difficult for older subjects to retrieve from memory, but a list of words drawn from a single conceptual category can be grouped together and the category name can be used as a retrieval cue.

In some experiments cues are provided at recall to facilitate the retrieval process. Experiments using this procedure also seem to support a retrieval explanation of age differences in secondary memory. If the elderly have a retrieval problem age differences should be reduced or even eliminated under cued-recall conditions.

Laurence (1967b) subjected young and elderly adults to a single study and recall trial of a 36-item list. The list was composed of six words chosen from each of six different categories. In one condition subjects were cued with the category names before the list was presented. This condition was expected to aid the subjects in rehearsal of the items. In another condition the category names served as retrieval cues, they were provided only during the recall period. A control condition also was included in the experiment. Subjects in the control group were not provided with cues at any time during the experiment. The results showed a significant interaction between age and the presence of rehearsal cues. Similar age differences were found in control subjects and in subjects who were given the category names before the list was presented. When the category names were provided at recall, however, age differences were eliminated.

In summary, an age-related retrieval deficit is indicated by cued-recall studies, comparisons of recall and recognition performance, and by experiments examining age differences in the recall of related and unrelated words. When the task conditions facilitate retrieval, age differences are minimized.

Acquisition and Organization

Although findings have generally supported the retrieval hypothesis, retrieval may not be the only source of difficulty for the elderly. Age decrements have also been attributed to deficits in acquisition and organization. It has been shown that the primary memory functioning of older adults is unimpaired; but when tasks involve a large secondary memory component, age differences are observed. Craik (1977) suggests that the elderly process stimulus material to a degree sufficient for short-term retention, but do not carry out the necessary encoding for long-term retention.

Several researchers have tested the hypothesis that age-related decrements in recall performance are due primarily to differences in degree of acquisition (Wimer & Wigdor, 1958; Hulicka & Weiss, 1965; Moenster, 1972). Hulicka and Weiss (1965), for example, had young and elderly subjects learn nine paired-associates under one of three conditions: equal learning opportunity, learning to criterion, or overlearning conditions. A subsequent retention test indicated that the older subjects learned less than younger subjects when the two groups had equal exposure to the material. The older subjects also required more trials to criterion under the learn-to-criterion condition, but after reaching criterion, the older subjects retained the material as well as young subjects. Overlearning did not benefit the elderly. The authors suggested that trials beyond criterion may have introduced negative motivational factors.

There is evidence that older subjects show acquisition deficits because they do not use the efficient encoding strategies adopted by younger adults. Long-term retention is positively affected by organization of the material (e.g., Tulving, 1962; Mandler, 1967) and by the use of mnemonic mediators (e.g., Paivio, 1971). These strategies are used to link or relate items together and have proven effective with college-age subjects. Several studies have demonstrated, however, that older subjects are disadvantaged relative to younger subjects when learning materials are easily organized.

Hultsch (1969) presented a multitrial free-recall task to three adult age groups. Subjects of each age group were assigned to three different instructional conditions. In one condition subjects were given standard free-recall instructions. A second group of subjects was given nonspecific instructions to organize the words. A third group was instructed to organize the words alphabetically. Hultsch found that while high-verbal-facility subjects showed no age decrement, low-verbal-facility subjects showed an age-related decrement in recall under two of the three instructional conditions. Age differences were evident with standard instructions and with nonspecific organizational instructions. The third set of instructions, instructions to alphabetize the words, led to insignificant age differences in recall performance. The results suggest that older subjects are benefited most by instructions which help them to organize efficiently.

In another experiment, Hultsch (1971) employed Mandler's (1967) sorting technique to investigate adult age differences in organization and recall. Half of the subjects were instructed to sort words into from two to seven categories prior to recall. The remaining subjects simply inspected the words before the test. Hultsch found no differences in sorting performance, but younger subjects recalled a greater number of words in a later retention test. Although age differences in recall were found when sorting was required, larger age differences resulted when subjects were not encouraged to organize the material. This finding is taken as support for the notion that age decrements in recall are partially due to organizational factors. The fact that age differences were found in recall, but not in sorting behavior is surprising in light of Mandler's (1969) report of a high correlation between recall and sorting. Perhaps sorting performance is not a good measure of organization.

Laurence (1966) reported similar findings using Tulving's (1962) measure of "subjective organization". Tulving reported a high correlation between recall and subjective organization; yet Laurence found that while young and old subjects differed in acquisition rate and recall performance, they displayed the same amount of organization. An explanation of these puzzling results is offered by Hultsch (1974). Hultsch demonstrated age decrements in organization using a modification of Bousfield and Bousfield's (1966) measure of intertrial repetition (ITR). He points out that other measures of organization are not sensitive to age differences because they tend to penalize younger subjects for learning more rapidly. Age differences in organization have also been shown using the "pair frequency" measure recommended by Sternberg and Tulving (1977) (Smith & Mason, in preparation). This measure is a bidirectional form of intertrial repetition which corrects for the expectation of the value of ITR.

Thus organization studies support the hypothesis that differences in degree of acquisition contribute to age-related decrements in recall performance. When appropriate measures are used, it is shown that older subjects are less likely to organize information. An acquisition deficit is also indicated in mediational studies. Older subjects report using mediational techniques less often than younger subjects (Hulicka & Grossman, 1967). Instructions to form mediators are of greater benefit to the elderly when subjects are permitted to develop their own associations between items (Treat & Reese, 1976), but older subjects receive little or no benefit from instructions which demand the use of specific mediators (Mason & Smith, 1977). It seems that older individuals are less able or less willing to perform those mental operations that result in a deep encoding of the to-be-learned materials.

Depth of Processing

The three-stage model of human memory is attractive in its simplicity. However, the identification and separation of sensory-, primary-, and secondary-memory functioning is not as clear cut as the model might lead one to believe. Craik and Lockhart (1972) have provided an alternative approach to human memory research in which memory is conceived of as a continuum; and processing stages are believed to be arranged in a series or a hierarchy. They suggest that a memory trace is the end product of perceptual processing. The durability of a trace is thought to depend upon the type of processing involved. A weak memory trace results when a shallow, peripheral analysis is carried out. Stronger, more enduring traces are formed when items are processed to a deeper, more meaningful level. According to the framework outlined by Craik and Lockhart, memory performance is a direct function of depth of processing, where depth refers to the degree of semantic involvement.

This theoretical proposal has important implications for the study of age differences in recall. If memory is viewed as a continuum dependent upon the level of encoding, then age-related decrements in recall performance can be explained in terms of a processing deficit. As discussed earlier, the exisiting data are in agreement with the notion that the elderly fail to carry out those mental operations which lead to strong memory traces. The processing strategies adopted by older adults are sufficient for short-term retention, but fall short when a task involves a large secondary memory component. It is important to note that while older subjects appear to use inadequate processing strategies, one can not conclude that older adults are incapable of performing the optimal mental operations. If the elderly are capable of processing to-be-learned material to a deeper level, then it should be possible to improve recall scores by providing older subjects with conditions which induce semantic encoding.

Incidental and Intentional Learning

A number of laboratory studies have included an incidental learning condition in an attempt to assess the learning potential of older subjects. In incidental learning, the subject is not given specific instructions to learn, he or she is simply instructed to answer questions about the items or perform some operation on each item as it is presented. The orienting task is assumed to control encoding or processing. For example, a structural task (e.g., letter checking) focuses the subject's attention on the physical characteristics of each item while a semantic task (e.g., rating words for pleasantness) forces the subject to consider the meaning of the words. In some cases the subject is instructed to learn some material but is tested on other material which was presented incidentally in the task. An unexpected recall or recognition test then follows.

Several investigators have demonstrated age differences in performance under incidental conditions (e.g., Bromley, 1958; Kausler & Lair, 1965; Nebes & Andrews-Kulis, 1976); but in other incidental learning studies no age differences were found (Hulicka, 1965; Speakman, 1954; Wimer, 1960). There is some indication that the type of incidental task used (Farrimond, 1968; Lauer, 1975) and the type of retention test given (Johnson, 1973) may determine whether or not the elderly perform as well as young adults under incidental conditions.

Experiments involving both incidental and intentional learning have provided evidence that age differences are smaller in incidental than in intentional or directed learning (Johnson, 1973; Wimer, 1960). While the scores of young subjects generally improve under instructions to learn, the scores of old subjects do not. It has been suggested that in the learning situation the older subject has difficulty controlling attention or set (Birren, 1974). As a result he or she does not concentrate on the information which is most relevant to the task. The finding has also been explained in terms of a processing deficit (Eysenck, 1974). The hypothesis is that the elderly use inefficient or irrelevant processing strategies when instructed to learn. Under incidental instructions it is assumed that all subjects treat the material in the same way, thus age differences in retention scores are minimized.

This view emphasizes the task which the subject must perform rather than his or her intent to learn; and this view is consistent with the depth of processing theory.

Orienting Tasks

Recent research conducted by Jenkins and his associates (Hyde & Jenkins, 1969, 1973; Johnston & Jenkins, 1971; Till & Jenkins, 1973) has established the fact that the recall performance of young adults varies as a function of the nature of the orienting task used. They found no differences between the recall performance of intentional control subjects and incidental subjects given a semantic orienting task. The control subjects were superior, however, to incidental subjects who were tested after a nonsemantic orienting task. The assumption is that young subjects spontaneously carry out those mental operations which result in a deep encoding. The list of semantic or facilitative tasks used by these investigators includes rating words for pleasantness (versus unpleasantness), rating words for activity (versus passivity), writing relevant adjectives or nouns, and estimating frequency of usage. Nonsemantic or non-facilitative tasks include letter checking (usually "e" or "g"), estimating letter length of words, writing rhyming words, syllable counting, voice identification (four voices), and identifying part of speech (Jenkins, 1974). After testing and rejecting hypotheses involving the amount of time and effort which semantic tasks require, Walsh and Jenkins (1973) concluded that it is the semantic processing itself that is important.

Craik and Tulving (1975) designed a series of experiments to investigate the effect of orienting tasks in greater detail. Three "levels of processing" were considered - structural, phonemic, and semantic. Subjects were instructed to answer "yes" or "no" to questions concerning the type script (e.g., "Is the word in capital letters?"), rhyme questions (e.g., "Does the word rhyme with _____?"), or category questions (e.g., "Is the word a type of _____?"). The results were consistent with a processing view. Semantic questions led to the highest recall performance; the next highest recall was associated with phonemic questions, and the poorest recall followed structural questions.

Hyde and Jenkins (1973) suggested that it is the nature of the encoding operation, not the incidental nature of the task which is the critical determinant of the pattern of results. To verify this notion Craik and Tulving (1975) examined the effect of three orienting tasks under incidental and intentional learning conditions. The same pattern of effect was observed under both conditions of intentionality.

The phenomenon appears to be quite robust. Craik and Tulving attempted to set up conditions which would minimize or eliminate the effects of differential encoding, but their attempts were unsuccessful. When the experiment was conducted as a classroom demonstration with very loose experimental conditions, the familiar pattern emerged. Furthermore, the main findings still occurred when differential rewards were offered for the recall of words associated with different orienting tasks.

In another experiment, Craik and Tulving (1975) demonstrated the orienting task effect in both recall and recognition. Although overall recognition was higher, the pattern was the same. Deeper encodings were associated with greater memorability. Unfortunately, Craik and Tulving did not include a no-orienting-task (standard) condition. An experiment with a standard learning condition would have provided a better comparison of the effects of orienting tasks on recall and recognition performance.

The existing data indicate that there are qualitative differences between recall and recognition memory when orienting tasks are, or are not, performed (Eagle & Leiter, 1964; Griffith, 1975; Woodward, Bjork, & Jongeward, 1973). Subjects who are required to perform a facilitative orienting task, such as rating words for pleasantness, recall as many words as subjects given standard learning instructions (Jenkins, 1974). A different finding is reported in recognition studies. Recognition performance following a semantic or facilitative orienting task is superior to performance following standard learning instructions (Elias

& Perfetti, 1973). One interpretation of these results is that the orienting task requirement provides an optimal encoding strategy for recognition but not for recall. Griffith (1975) proposed that recognition performance is enhanced by elaborative strategies whereby the subject focuses on the characteristics of each individual item. The orienting tasks typically included in incidental learning studies can be classified as elaborative tasks. Griffith further proposed that recall depends more upon organizational processes than elaboration. Superior recall performance results when subjects are encouraged to develop interitem associations.

To test the notion that different processing strategies are optimal for recall and recognition, Griffith (1975) employed an incidental learning paradigm. Subjects were instructed to perform a categorization task designed to induce organization, an imagery task designed to induce elaboration, or were given intentional standard learning instructions. Griffith found that while the imagery task was optimal for recognition, the categorization task and intentional learning instructions were more effective for recall.

The fact that organizational tasks and standard instructions functions similarly suggests that young subjects spontaneously use organization in the learning situation.

The high recognition scores which follow elaborative orienting tasks demonstrate that young subjects can also be encouraged to use elaboration. Moreover, subjects process material differently when told to expect a recognition or a recall test (Tversky, 1973). In other words, when subjects are uninformed as to the nature of the retention test, they tend to organize; but when forwarned, subjects use the most appropriate strategy - organization in anticipation of recall and elaboration in anticipation of recognition.

It is now well established that the performance of young adults is primarily a function of the level of encoding, as determined by the nature of the orienting task. Tasks which foster organizational processing and elaboration are associated with better retention. Can the generality of these findings be extended to other populations of subjects? In particular, would elderly subjects show exactly the same pattern of results? There are indications that the elderly use irrelevant processing strategies and organize less effectively, but the evidence comes primarily from recall studies. Little or no age decrement is found when retention is measured with a recognition test. If a distinction is made between organizational processing and elaboration, the former being the optimal encoding process for recall and the latter being the optimal strategy for recognition; then age differences in recall should be attributed to an organizational processing deficit, rather than an inability of the elderly to use effective processing strategies. It could be argued that older adults use elaborative strategies as well as young adults; but because they use organizational strategies less effectively, the relationship between standard learning instructions and orienting task instructions would differ in different age groups.

Previous research comparing the effects of orienting tasks on the performance of subjects in different adult age groups has been inconclusive. A study by Eysenck (1974) tested age differences in recall following different orienting task requirements. Five task groups were included in the study. Four of the groups (letter counting, rhyming, adjective, and imagery) were given incidental learning instructions. The fifth group was a control group given intentional learning instructions. Eysenck found significant age differences in three of the five conditions, the two orienting task conditions which involved semantic processing (i.e., selecting an appropriate adjective and forming an image) and the control condition. It was concluded that age differences in recall are due to an inability of older adults to process material at a deep, semantic level.

Whereas Eysenck (1974) interpreted his data as showing an age-related processing deficit, another orienting task study emphasized age differences in retrieval. White and

Craik (in Craik, 1977) presented young and old subjects with a list of 64 words. The first 48 words were presented under incidental learning conditions. Subjects were required to perform three different orienting tasks, each task on 16 words. Orienting task questions were of the following form: 1) Is the word in capital letters? 2) Does the word rhyme with _____? 3) Does the word belong to the _____ category? (animal, vegetable, or mineral). The last 16 words were presented under intentional learning conditions. After all 64 words had been presented, subjects were tested on their retention of the entire list. All subjects were given a recall test followed by a recognition test. The recall results were in agreement with Eysenck (1974); age decrements were substantial under two instructional conditions - the category orienting task condition and intentional learning. With the recognition test, age differences were eliminated in the category condition but not in the intentional learning condition. White and Craik contended that the elderly processed the category items at a deep, semantic level but were unable to recall as well as young adults because of retrieval problems. The finding of an age decrement in recognition following instructions to learn is surprising in light of earlier work (e.g., Craik, 1971; Smith, 1975). Craik (1971) himself reported no age difference in recognition; yet, in the same laboratory, White and Craik found a substantial age decrement. This discrepancy is probably due to the fact that both type of task and method of test were manipulated within subjects in the White and Craik experiment. In a within-subjects design the learning conditions can not be properly controlled. Processing of the to-be-learned items in the standard condition is likely to be affected by the type of processing required in the incidental conditions. This procedure confounds the important comparison between standard instructions and orienting task instructions. As stated by Underwood and Shaughnessy (1975):

> There are certain independent variables that cannot be effectively manipulated by a within-subjects design. As a general statement, it may be said that any type of an instructional variable cannot be effectively handled by giving all of the conditions to the same subject. ...Could (or would) the subject "turn off" the strategy when he is given the control condition? Probably not. (p. 72)

Perlmutter also used a completely within-subjects design and reported results similar to those reported by White and Craik (in Craik, 1977). Perlmutter assessed age differences on a variety of memory tasks. One task required subjects to generate associations to the items in a list (incidental learning). In another task subjects were instructed to learn a list of words. Subjects were subsequently tested for recall and recognition of both incidentally and intentionally learned material. Young subjects recalled significantly more words under both instructional conditions. And, as in the White and Craik study, there were no age differences in the recognition of incidentally learned material, but a significant age decrement was found in the recognition of intentionally learned material.

A better technique for comparing the effects of orienting tasks on the memory performance of different age groups is a between-subjects design, where different groups of subjects are assigned to different task conditions and all subjects are given intentional learning instructions. This type of design allows the researcher to evaluate the effect of an orienting task relative to intentional learning instructions without the confounding inherent in having the same subjects experience both.

In one such study, Warrington and Ackroyd (1975) used a between-subjects design to examine the effects of orienting tasks on the performance of older subjects. They were interested in whether the orienting task effect would hold for nonverbal stimuli, namely faces. Three instructional conditions were used for two classes of stimuli, words and faces. In the "no-orienting-task" condition subjects were merely instructed to attend to each stimulus item. In the "relevant-orienting-task" condition subjects were required to categorize each stimulus item as pleasant or unpleasant. Finally, in the "nonrelevant-orienting-task" condition subjects were required to categorize each word stimulus as green or red and in the case of the face stimuli as tall or short. All of the subjects were informed that retention would be tested. A recognition test was administered following the stimulus presentation. The results showed an improvement in performance on the relevant-orienting-task condition compared with both the no-orienting-task (standard) condition and the nonrelevant-orienting-task condition. This was true for both faces and words. The pattern is the same as that obtained in earlier investigation with younger subjects. A task condition which induces a deep, semantic encoding is associated with higher recognition scores than a standard control condition.

Unfortunately, the Warrington and Ackroyd (1975) study did not investigate age differences. All of the subjects were between 50 and 70 years old. Smith and Winograd (1977) included two adult age groups (college students and adults 50-80 years) in an experiment designed to test age differences in memory for faces. Subjects were assigned to one of three encoding conditions. In one condition subjects attended to a structural feature of each face; they were to indicate whether or not the face had a "big nose". Another group of subjects had to determine whether or not each face was "friendly". In the third condition subjects were given standard learning instructions.

All groups were told to expect a retention test. While the younger subjects correctly recognized more faces than the older subjects, there was no significant interaction between age and task condition. Subjects who were required to judge the friendliness of each face recognized more faces than subjects in either the structural orienting task condition or the standard control condition.

The results reported by Warrington and Ackroyd (1975) and Smith and Winograd (1977) indicate that a task which forces subjects to encode stimuli at a deep level facilitates the recognition performance of both young and old subjects. It was shown that subjects of both age groups demonstrate better recognition when they judge how pleasant or how friendly items are than when they are simply instructed to learn the items. A contrary conclusion was drawn by White and Craik (in Craik, 1977) and Perlmutter (1977) who found larger age differences in recognition following standard learning instructions than following a meaningful task requirement (i.e., answering category questions and generating associations). There is a need for a more systematic investigation of task effects on age differences in recall and recognition memory. A well controlled study including between-subjects manipulation of encoding tasks commonly used with young adults would provide important data regarding age decrements in stimulus processing. This is the purpose of this thesis.

Methodological Issues in Aging Research

There are three basic methods used in gerontological research: cross-sectional, longitudinal, and cross-sequential. Most laboratory studies demonstrating a decline in memory performance with age have been cross-sectional; that is, subjects at different age levels have been compared on the same task and at the same time. A major source of difficulty with this design is that the effects of age and date of birth are confounded. In the cross-sectional design it is assumed that subjects in different age groups are comparable with respect to factors other than those being tested (e.g., health, socio-economic status, level of education), but subjects within an age group are of a common birth cohort and their experiences are most likely not comparable to the experiences of younger and older generations.

Age effects are separated from generational or secular effects in the longitudinal design. With the longitudinal method repeated measures are taken on the same sample of subjects on two or more occasions. All subjects are selected from the same birth cohort and age becomes a within-subjects variable. A major problem with this method is that age is confounded with time of measurement; and it is not possible to assess age changes independent of environmental influences.

The third method of research is the cross-sequential method recommended by Schaie (1967, 1975) and Baltes (1968).

In a cross-sequential study both the advantages of cross-sectional and longitudinal comparisons are included in a single design. Subjects sampled from different birth cohorts are tested and then retested at a later date. In addition, independent samples of subjects from the same cohort are selected and tested. This method allows the researcher to separate the relative contribution of the effects of age, cohort, and time of measurement. The scores of different age groups on the same test are compared to assess the generational change component (i.e., birth cohort effects) and the initial and follow-up test scores of the same subjects (or independent samples from the same cohort) can be compared to measure the ontogenetic change component (i.e., age effects). When cross-sectional comparisons show age-related differences which are not demonstrated in longitudinal data, it is concluded that the age differences represent cohort effects rather than age changes.

Schaie and his associates (Schaie & Labouvie-Vief, 1974; Schaie, Labouvie, and Buech, 1973; Schaie & Strother, 1968a,b) have employed the cross-sequential method in studies of adult development in intelligence. While longitudinal comparisons showed little or no decline in performance, age decrements were found in cross-sectional comparisons. It was concluded that performance on measures of intelligence remains fairly stable across the life span.

Cross-sectional differences were attributed to cohort effects. These results led a number of investigators to question the use of cross-sectional designs in aging research. It was demonstrated that cohort has an impact on performance on intelligence tests and therefore conclusions about age changes in intelligence can not be drawn from cross-sectional studies; but this finding should not be taken as evidence that the cross-sectional method is inappropriate for all gerontological research.

Cross-sectional studies of learning and memory performance provide important data for the psychologist and the educator. With a cross-sectional design researchers can test hypotheses about how specific conditions differentially affect the performance of current young and old adults. And if the investigator is interested in understanding the effects of aging on learning and memory performance, cross-sectional studies may contribute to that understanding as well. There is evidence that cohort effects on learning are minimal.

Arenberg (1967; Arenberg & Robertson-Tchabo, 1977) has reported relevant data from the Baltimore Longitudinal Study. The cross-sequential design was used to examine changes in serial and paired-associate learning across the life span. Two types of data were collected, repeated measures taken at least six years apart and independent samples from the same cohorts tested during two separate periods. The repeated measures data, intra-cohort comparisons, and cross-sectional comparisons indicated similar declines in memory performance. Arenberg concluded that cohort differences have an insignificant effect on age changes in verbal learning and memory.

The Baltimore Longitudinal Study provides evidence that the cross-sectional design is an appropriate method for investigating the effects of aging on learning performance, for "if we have reason to believe that secular trends in (a variable) are nil or small, then we may choose to disregard them and feel free to select from a wide range of cohorts" (Bromley, 1974, p. 346).

Statement of the Problem

In the present research a cross-sectional design was used to assess age differences in stimulus encoding. The effects of different orienting task requirements on the recall and recognition performance of three age groups were examined.

The experiment included three orienting task conditions (a structural task, a phonemic task, and a semantic task) and a standard "no-orienting-task" condition. Retention was measured with a recognition test for half of the subjects and with a recall test for the remainder of the subjects. The same stimulus materials and pacing conditions were used throughout the experiment so that any condition could be compared with any other condition. Hypotheses regarding the interactions are stated below.

H_1: Structural or "case" questions will lead to the poorest recall and recognition performance; the next poorest performance will be associated with phonemic or "rhyme" questions; and a high level of recall and recognition will follow semantic or "category" questions. This pattern will hold for all three age groups. The largest age difference will be in the semantic task condition.

H_2: The youngest subjects will recall the largest proportion of stimulus items. However, in the recognition test all three age groups will perform significantly better than in the recall test; and the greatest improvement will be shown in the oldest subjects.

H_3: A significant orienting task by retention test interaction is hypothesized. The recognition scores will be higher in the category task condition than in the standard learning condition, while recall scores will be equivalent across the two tasks.

H_4: The category task is considered an elaborative task and is not expected to improve recall scores; that is, young and old subjects in the category task condition will recall as many words as subjects given standard learning instructions. Unlike recall, recognition is enhanced by elaboration. It is predicted that young subjects will demonstrate better recognition performance following the category questions than following standard learning instructions. If older adults tend to use elaborative rather than organizational encoding processes, then elderly subjects in the category and standard conditions should perform similarly on the recognition test.

CHAPTER II

METHOD

Subjects

Four-hundred ninty-eight, healthy, active adults from the Atlanta area served as subjects. Civic, church, and social clubs in the area were contacted and the group members were invited to participate. Subjects were run in groups during each organization's regularly scheduled meeting. In return for their participation in the experiment, groups were provided with a program on memory and were offered a donation of $30.00 for the club's treasury.

Design

Subjects at each test session were assigned to the conditions of a factorial design which included the following variables: age (20-39 years, 40-59 years, and 60-80 years), type of retention test (recall or recognition), and type of orienting task (standard, case, rhyme, or category). Within age groups, subjects were randomly assigned to conditions. The design of the experiment, including the number of subjects obtained in each cell, is depicted in Table 1.

Test Stimuli and Orienting Tasks

The same 60-item list used by Craik and Tulving (1975,

Table 1. Design of the Experiment

Age Group	Orienting Task	Retention Test	N
20-39 yrs.	Standard	Recall	20
		Recognition	22
	Case	Recall	22
		Recognition	23
	Rhyme	Recall	22
		Recognition	21
	Category	Recall	22
		Recognition	20
40-59 yrs.	Standard	Recall	17
		Recognition	17
	Case	Recall	15
		Recognition	16
	Rhyme	Recall	18
		Recognition	17
	Category	Recall	18
		Recognition	18
60-80 yrs.	Standard	Recall	22
		Recognition	21
	Case	Recall	26
		Recognition	24
	Rhyme	Recall	26
		Recognition	23
	Category	Recall	25
		Recognition	23

Experiment 9) is provided in Appendix A. The list is composed of one- and two-syllable words of four, five, or six letters. These common English nouns served as test stimuli for all subjects.

One fourth of the subjects in each age group were assigned to each of the task conditions. No orienting task was given to the subjects in the standard condition. Their test booklets contained a page with the numbers one through 60 printed on it. These subjects were simply instructed to study each word as it was presented and place a check mark beside the appropriate number. In order to answer the questions for the orienting tasks, the subjects in those conditions had to look away from the screen and mark their booklets. The checking task was included in the standard condition to control the amount of time "standard" subjects viewed each word.

In the three orienting task conditions subjects were asked questions concerning the type script (e.g., Is the word printed in capital letters?), rhyme questions (e.g., Does the word rhyme with EACH?), or category questions (e.g., Is the word a form of communication?). These are the three orienting tasks used by Craik and Tulving (1975). The questions are given in Appendix A. The test booklets contained 60 questions numbered one through 60. Subjects were to study a question, look at the word presented, and then answer the question by checking "YES" or "NO". For half of the questions the correct response was "YES" and for half the correct response was "NO".

Retention Tests

Within each orienting task condition half of the subjects were tested for recall and half for recognition. The recall subjects were given a blank sheet of paper on which they were to write as many words as they could remember having seen on the screen. Recognition subjects received a list of 180 words consisting of the 60 target items plus 120 distractor items. A sample recognition test is provided in Appendix B. These subjects were asked to examine each item and indicate whether it was "old" or "new".

Procedure

Test booklets were compiled so that subjects within a test group might be assigned to different experimental conditions. Test booklets included a cover sheet (on which subjects indicated their age), an instruction sheet, an orienting task, and a retention test.

At the start of the experiment subjects were told that they all had different tasks to perform. If they had any questions they were to raise their hands. Questions were answered individually. The instruction sheet in each booklet informed the subject that 60 words would be presented at a five-second rate. As the words were presented the subject was to perform a particular orienting task. It has been determined that young adults differentially encode information in anticipation of a recall or recognition test (Tversky, 1973). To avoid a possible confounding of effects, subjects were told that a retention test would be given but they did not know what type of test to expect. When the experimenter had determined that all of the subjects read and understood their instructions, the experiment began. Appendix C contains the instructions given in each of the task conditions.

A Kodak Carousel slide projector with an internal timer was used to present the stimuli. Slides were made of the 60 nouns; half of the words typed in capital letters and half typed in small letters. The 60 words were presented one at a time, for a period of five seconds. The experimenter counted the slides aloud as they appeared on the screen.

After the stimulus presentation, subjects were instructed to turn to the test pages of their booklets. They were informed that if their booklet contained a blank sheet of paper, they were to take a recall test, to write down as many of the words as they could remember having seen on the screen. Those subjects whose booklets contained a recognition test were told to go through the list of words and indicate which words had been presented on the screen by marking the "Y" (for yes) given beside the words. The "N" (for no) was to be marked beside new words, words which had not been presented on the screen. All subjects were told not to look back in their booklets, to work only on the test pages. Retention tests were not paced. Recall subjects and recognition subjects who finished early were asked to close their booklets and sit quietly.

CHAPTER III

RESULTS

Recognition

Recognition scores for the three age groups under each orienting task condition are presented in Table 2. Mean hit rate, mean false alarm rate, and mean *d'* scores are provided. The *d'* measure is calculated from the observed hit rate (probability of a correct recognition) and false alarm rate (probability of a false recognition). It is based on the signal detection model of recognition memory and is an unbiased estimate of memory strength. The *d'* scores were subjected to an analysis of variance. Table 3 contains the summary table for the analysis of these recognition data. The main effects of age ($F(2,233)=9.18$, $p<.001$) and orienting task ($F(3,233)=44.68$, $p<.001$) both proved to be significant. In addition, there was a significant interaction between the age variable and the task variable ($F(6,233)=2.40$, $p<.05$). The interaction is depicted in Figure 1.

Pairwise comparisons among means were made using Tukey's HSD test (Kirk, 1968). Two types of comparisons were of interest; those involving subjects within an age group but under different orienting task conditions, and those involving subjects of different age groups under the same ori-

Table 2. Recognition Performance Under Each Orienting Task Condition

Orienting Task	Age Group	N	Mean Hit Rate	Mean False Alarm Rate	Mean d' Score
Standard	1	22	.66	.09	1.89 (.65)[1]
	2	17	.64	.12	1.82 (.83)
	3	21	.57	.09	1.74 (.65)
Case	1	23	.50	.15	1.10 (.51)
	2	16	.53	.18	1.15 (.56)
	3	24	.41	.16	.90 (.46)
Rhyme	1	21	.50	.08	1.49 (.48)
	2	17	.44	.15	1.06 (.43)
	3	23	.43	.11	1.19 (.61)
Category	1	20	.71	.03	2.54 (.51)
	2	18	.59	.04	2.17 (.70)
	3	23	.52	.07	1.67 (.51)

[1]Standard deviations are presented in parentheses.

Table 3. Analysis of Variance Summary Table: Recognition Scores (_d_')

Source	Sum of Squares	df	Mean Square	F	p Less Than
Within Cells	78.02	233	.34	-	
Age	6.15	2	3.07	9.18	.001
Task	44.88	3	14.96	44.68	.001
Age X Task	4.82	6	.80	2.40	.029
Total	133.87	244	-	-	

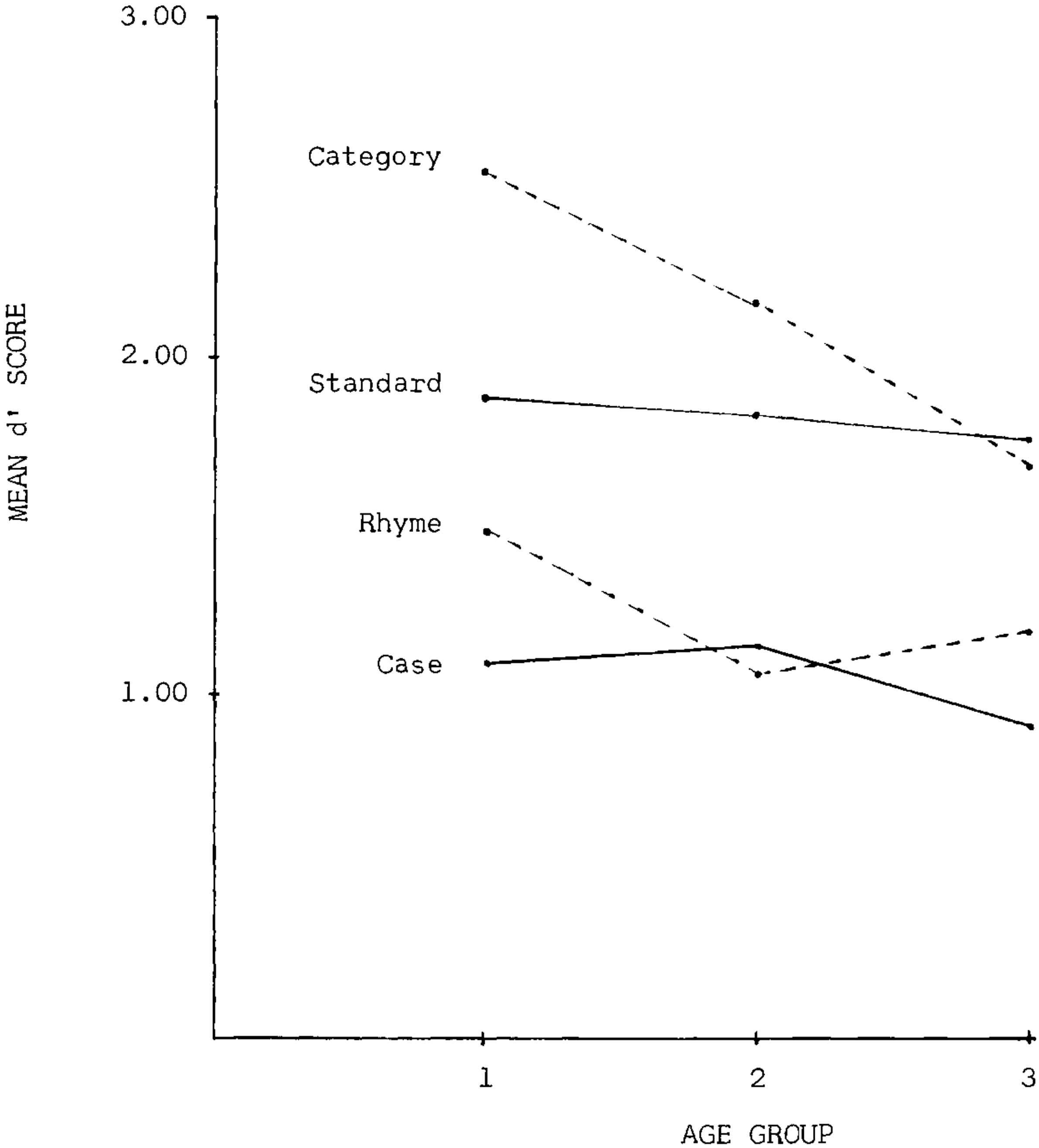

Figure 1. The Effects of Orienting Tasks on the Recognition Performance of Young (Group 1, 20-39 yrs.), Middle-Age (Group 2, 40-59 yrs.), and Old (Group 3, 60-80 yrs.) Adults.

enting task condition. Differences among the means are presented in Table 4. Several significant differences were found. Pairwise comparisons among the means for the youngest groups of subjects revealed that subjects in the category task condition performed significantly better than those given standard instructions, case questions, or rhyme questions. Case questions led to the poorest level of recognition performance; young subjects in the case orienting task condition retained significantly less than those in the standard condition.

The results for the middle-age group differ from those obtained with younger subjects. The *d'* scores of middle-age subjects in the category and standard conditions did not differ significantly, but their scores were significantly higher than the scores of subjects in either the rhyme or case condition. Two significant differences were found within the oldest group of subjects. Both category and standard subjects recognized significantly more words than did case subjects.

Comparisons of different age groups within an orienting task condition revealed only one significant difference, that was the difference between the means of young and old subjects in the category condition. Young subjects performed significantly better than old subjects following category questions.

Table 4. Differences among Means: Recognition Scores

		Group 1				Group 2				Group 3			
		St	Case	Rh	Cat	St	Case	Rh	Cat	St	Case	Rh	Cat
Group 1	St		.79*	.40	.65*	.07				.15			
	Case			.39	1.44*		.05				.20		
	Rh				1.05*			.43				.30	
	Cat								.37				.87*
Group 2	St						.67*	.76*	.35	.08			
	Case							.09	1.02*		.25		
	Rh								1.11*			.13	
	Cat												.50
Group 3	St										.84*	.55	.07
	Case											.29	.77*
	Rh												.48
	Cat												

*p<.05

Recall

Recall scores for young, middle-age, and old subjects under the four orienting task conditions are presented in Table 5. The mean number of intrusions and the mean number of words correctly recalled are shown.

Prior to the analysis the statistic F_{max} was used to test the assumption of homogeniety of variance. The test led to a rejection of the hypothesis. Because the recall scores were low and positively skewed, transformations failed to produce the desired homogeniety. Trusting to the robustness of the F distribution, the recall scores were analyzed using analysis of variance. The summary table for the analysis of the recall scores is provided in Table 6. Main effects of age ($F(2,241)=27.37$, $p<.001$) and orienting task ($F(3,241)=53.05$, $p<.001$) were found to be significant. The interaction between the two variables also proved to be significant ($F(6,241)=6.00$, $p<.001$). The age by task interaction is presented in Figure 2.

Tukey's HSD test was used to make selected pairwise comparisons among means. Table 7 contains the table of differences among means. The pattern of results was similar for the two youngest age groups. For these two groups, recall scores under the category and standard conditions were statistically equivalent. And, category and standard subjects recalled a significantly greater number of words than

Table 5. Recall Performance Under Each Orienting Task Condition

Orienting Task	Age Group	N	Mean Number of Intrusions	Mean Number of Words Correctly Recalled
Standard	1	20	2.68	11.30 (5.29)[1]
	2	17	5.24	12.24 (6.52)
	3	22	3.18	5.64 (3.36)
Case	1	22	2.73	3.96 (3.21)
	2	15	2.13	3.00 (2.14)
	3	26	2.42	3.65 (3.59)
Rhyme	1	22	3.05	4.91 (2.86)
	2	18	3.39	3.94 (2.13)
	3	26	2.38	2.46 (2.64)
Category	1	22	.82	15.41 (7.06)
	2	18	1.11	13.78 (3.98)
	3	25	2.40	6.44 (5.92)

[1]Standard deviations are presented in parentheses.

Table 6. Analysis of Variance Summary Table: Number of Words Correctly Recalled

Source	Sum of Squares	df	Mean Square	F	p Less Than
Within Cells	4631.00	241	19.22	-	
Age	1051.98	2	525.99	27.37	.001
Task	3058.07	3	1019.36	53.05	.001
Age X Task	691.85	6	115.31	6.00	.001
Total	9432.90	252	-	-	

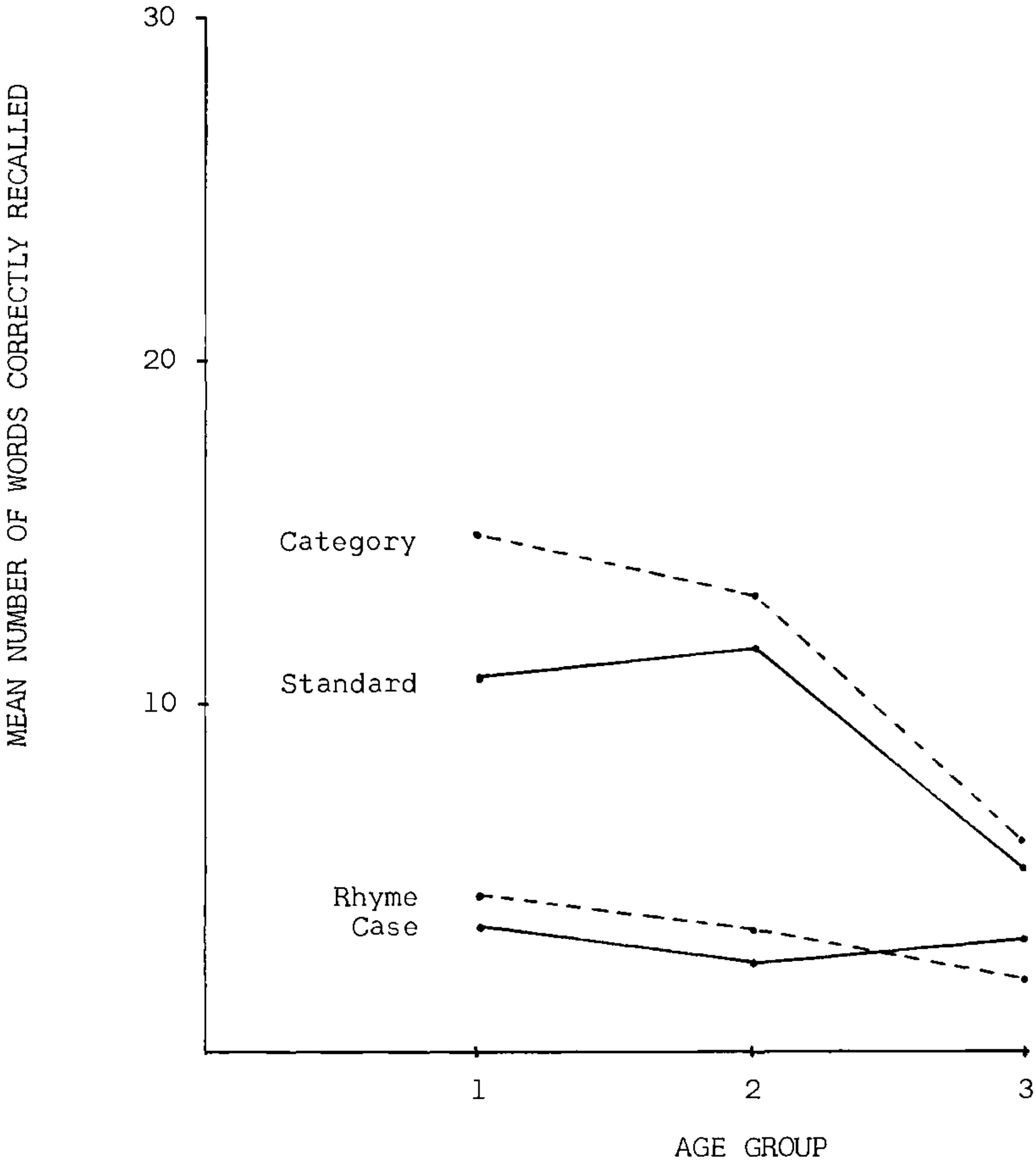

Figure 2. The Effects of Orienting Tasks on the Recall Performance of Young (Group 1, 20-39 yrs.), Middle-Age (Group 2, 40-59 yrs.), and Old (Group 3, 60-80 yrs.) Adults.

Table 7. Differences among Means: Recall Scores

		Group 1				Group 2				Group 3			
		St	Case	Rh	Cat	St	Case	Rh	Cat	St	Case	Rh	Cat
Group 1	St		7.34*	6.39*	4.11	.94				5.66*			
	Case			.95	11.45*		.96				.31		
	Rh				10.50*			.97				2.45	
	Cat								1.63				8.97*
Group 2	St						9.24*	8.30*	1.54	6.60*			
	Case							.94	10.78*		.65		
	Rh								9.84*			1.48	
	Cat												7.34*
Group 3	St										1.99	3.18	.80
	Case											1.19	2.79
	Rh												3.98
	Cat												

*p<.01

did subjects in either the rhyme or the case conditions. Comparisons among means for the oldest subjects in various task conditions revealed that none of the differences was significant; that is, standard instructions, case questions, rhyme questions, and category questions all had similar effects on the recall performance of this age group. It is likely that this is due to low levels of recall because of the difficulty of the list (i.e., "basement effects"). Finally, when comparisons of the three different age groups were made, it was discovered that the young and middle-age subjects were superior to the oldest subjects under two conditions, the standard "no-orienting-task" condition and the category task condition.

Yes/No Differences

For each of the three non-standard task conditions, half of the questions yielded "yes" responses and half yielded "no" responses. The proportion of yes and no words correctly recalled and recognized are presented in Table 8. Yes responses to category questions were accompanied by higher subsequent recall and recognition scores than the no responses. This was true for both the younger and the older subjects. A yes/no difference was also found in two other conditions. The young subjects recognized more yes words than no words following the rhyme orienting task; and the old subjects demonstrated a yes/no difference when re-

Table 8. Yes/No Differences

		Proportion Recalled		Proportion Recognized	
		Yes Words	No Words	Yes Words	No Words
Young Subjects:	Case	.07	.06	.50	.50
	Rhyme	.09	.07	.55	.45
	Category	.31	.20	.83	.59
Older Subjects:	Case	.07	.05	.46	.36
	Rhyme	.05	.03	.44	.42
	Category	.14	.07	.59	.45

cognition was tested in the case condition.

The superior retention of positive decision words has been reported in previous orienting task studies (e.g., Schulman, 1974; Craik & Tulving, 1975). This finding is most likely to occur when the encoding question and the to-be-learned item form a coherent, integrated unit. Positive responses to the category questions of the present experiment should lead to congruous encodings; and indeed, a yes/no difference was reliably demonstrated with the category orienting task. Because these data are ancillary to the main findings of the study, they will not be discussed further.

CHAPTER IV

DISCUSSION

The major purpose of this study was to investigate age differences in stimulus encoding. Encoding strategies were indirectly assessed by testing recall and recognition memory following various orienting task requirements. Four task conditions were included in the experiment, three orienting task conditions and a standard condition. Subjects in the four task groups were exposed to the same stimulus materials and the same pacing conditions; and all subjects were given intentional learning instructions but were not told what type of retention test to expect. Hence orienting task requirement was the only variable manipulated at encoding. The learning situation was otherwise identical for all groups.

The three orienting tasks used in the experiment are assumed to represent three levels of processing. Previous research with young adults has shown that mnemonic performance is related to the level of encoding induced by the orienting task (e.g., Craik & Tulving, 1975; Schulman, 1971). Depth of processing refers to the amount of semantic involvement at encoding; and the greater the semantic involvement, the stronger the memory trace. The category task used in the present experiment is a semantic task which is assumed to lead to a deep, meaningful encoding. Subjects in the category task condition had to determine whether the word presented was a member of a particular category. In the rhyme task condition, attention was focused on the sounds rather than the meaning of the word. Therefore, this task was expected to result in poorer recall and recognition performance. Finally, the case task simply required subjects to decide whether the word was printed in capital letters or small letters. This decision could be made by examining one letter of the word. Consequently, the case task should result in a very weak memory trace. It was predicted that, of the three orienting task requirements, category questions would lead to the highest level of recall and recognition performance, followed by rhyme questions; and case questions would be associated with the poorest recall and recognition scores. It was further hypothesized that this pattern would be demonstrated in all three age groups.

Under the conditions of the present experiment, rhyme questions did not lead to better recall and recognition than case questions (see rhyme and case plots in figures 1 and 2). The two orienting tasks were functionally equivalent for all three age groups in both test conditions. In addition, performance under these two task conditions was similar across age groups; that is, the test scores of young subjects were no better than the scores of older subjects following rhyme and case questions. It seems that in this study the rhyme and case tasks fostered the same low level of stimulus encoding. Craik and Tulving (1975) reported a significant difference in the retention of words associated with rhyme and case questions. The superior retention of rhyme words was predicted, but not found in the present study. It is likely that the orienting task effect was enhanced in Craik and Tulving's research because they manipulated task as a within-subjects variable.

Craik and Tulving (1975) demonstrated the superiority of category questions over case and rhyme questions; and in the present experiment the category task was more effective than either the rhyme or the case task for the young and middle-age subjects, but not for the oldest subjects. All three task conditions led to the same level of recall for the oldest group. This result may in part be due to the fact that the recall scores were very low. However, there was no evidence of a "basement" effect in recognition, and category and rhyme questions were also equivalent for the older subjects tested for recognition. The important finding here is the age decrement in performance following the category task requirement. No age differences were found with the other two orienting tasks. The category task effectively induced deeper encoding for the two younger age groups, but was no more effective than the rhyme task for the oldest group.

At first glance these results might be taken as support for the processing-deficit hypothesis (Eysenck, 1974). The young adults seem better able to carry out deep, elaborative encodings. But when these data are considered in conjunction with the scores of subjects given standard learning instructions, another interpretation is possible.

As in previous research (Schonfield & Robertson, 1966; Craik, 1971; Smith, 1975), when subjects were given standard learning instructions with no orienting task, there were age differences in recall but not in recognition. The two youngest groups recalled significantly more words than the oldest group. However, all three age groups demonstrated the same high level of recognition performance. The explanation often given for this finding is that the elderly have difficulty retrieving information from memory at the time of recall. A recognition test requires the matching of test items with information stored in memory. Presumably, age differences are minimized or eliminated with a recognition test because it reduces the retrieval requirement of the task. The retrieval hypothesis has not gone unchallenged, however (Drachman & Leavitt, 1972; McNulty & Caird, 1966, 1967). Retrieval obviously depends upon encoding; and some investigators have taken the position that age-related memory deficits result from an inability of the elderly to encode items effectively so that less information is available for retrieval. The data obtained in the present investigation are more consistent with a processing or encoding interpretation than with a retrieval explanation. The hypothesis to be advanced here is that age differences in recall are due to the spontaneous use of different processing strategies by young and old subjects during learning.

To successfully recall information, it must be encoded and later retrieved. Thus, an encoding strategy which facilitates retrieval should enhance recall. It has been theorized that recall depends upon the formation of associations and interrelations (Anderson, 1972). If items are organized at input, then easily recalled items should serve as retrieval cues for other list items. Recognition involves a minimal amount of retrieval. To perform well on a recognition test, the learner must encode enough information about each stimulus item to discriminate between test items and distractor items. Therefore, elaborating upon items and integrating the details of each item should enhance recognition, whereas forming interitem associations and organizing list items should aid recall.

Griffith (1975) demonstrated that different encoding operations are effective for recall and recognition. College-age subjects were assigned to three different instructional conditions and were tested for either recall or recognition. Recall scores were high under two conditions, when subjects were given intentional learning instructions and when subjects were given an incidental task which demanded organization of the to-be-learned items. The third instructional condition, an incidental task requiring elaboration of each individual item, resulted in the lowest recall scores but the highest recognition scores. Griffith concluded that organizational strategies are optimal for recall whereas elaborative strategies are optimal for recognition.

Though it is likely that all subjects engage in some organizational and elaborative encoding, there may be age differences in the relative use of the two strategies. To the extent that age differences in memory performance are due to differences in processing, the organization/ elaboration distinction can explain the finding of greater age decrements in recall than in recognition. If young subjects tend to link the items in a list together, perhaps in anticipation of a recall test, then they should have the greatest advantage when recall is the method of testing. Similarly, if older adults tend to elaborate on items at input, spending less time on organizational operations, then they should benefit disproportionately when a recognition test is administered.

The category task of the present experiment is considered an elaborative task because each word is associated with a different category. Therefore, it is not surprising that young subjects in the category task condition recognized more words than the young subjects in the standard learning condition. And, as predicted, young subjects in the category and standard conditions performed similarly on the recall test. The interesting finding is that the older subjects did not benefit from the category task instructions (elaborative) on either retention test. This result supports the hypothesis of age differences in processing. If older subjects used elaboration effectively, then they would not be expected to receive any further benefit from a task which requires elaboration.

The existing data concerning age decrements in organization are also congruous with the idea that older subjects tend to elaborate while young subjects organize. Laurence (1966) used Tulving's (1962) index of subjective organization to analyze the recall protocols of four age groups of children and young and old adults. Although Laurence reported no age differences in amount of organization, it has been suggested that subjective organization is not an appropriate measure (Hultsch, 1974; Sternberg & Tulving, 1977). In fact, Sternberg and Tulving (1977) reanalyzed the data that Laurence collected with children showing no age effect, and when a more appropriate measure of organization was used (i.e., pair frequency) it was shown that organization did increase with age. It is likely that a reanalysis of the data collected with adults would also reveal age differences. Hultsch (1974) found adult age differences in organization using a modification of Bousfield and Bousfield's (1966) measure of intertrial repetition. And Smith and Mason (in preparation) demonstrated age differences using the method recommended by Sternberg and Tulving (1977).

There are age decrements in organization but it does not seem to be an inability of the elderly to perform those mental operations carried out by younger adults. With the proper instructions older adults can be encouraged to organize effectively (Hultsch, 1969, 1971). Hultsch (1969) eliminated age differences in recall performance by instructing subjects to alphabetize a list of words. In another experiment, Hultsch (1971) investigated age differences in organization and recall using Mandler's (1967) sorting technique. Again older subjects were disproportionately benefited by instructions to organize the material.

In summary, it was demonstrated that young and old subjects are differentially affected by orienting task requirements. Recall scores of young, middle-age, and old subjects did not improve under the category task condition, presumably because the category task induced elaboration and elaboration is not an optimal strategy for recall. Age differences in recall were attributed to the tendency of young adults to employ organizational processing strategies while older adults use a plan less effective for recall.

While there were no age decrements in recognition when subjects were given standard learning instructions, there was a significant difference between age groups following the category task requirement. The difference was due to the superior performance of young subjects in the category condition. It was suggested that older adults study items individually rather than relating them together as young adults do. Thus, when an orienting task fosters elaboration, young adults are aided more on a subsequent recognition test.

CHAPTER V

FUTURE INVESTIGATIONS

The results of the present experiment suggest several testable propositions. It was hypothesized that young and old adults do not use the same learning strategies; young adults tend to organize while old adults tend to elaborate. The orienting task and organization literature provide evidence that with proper instructions, young subjects can be encouraged to focus on the characteristics of individual items (and thus improve recognition scores) and older subjects can be encouraged to form interitem associations (and thus improve recall scores). The argument would be more compelling with support from a study following the techniques of Griffith (1975), where age, task (organizational, elaborative, and standard), and test (recall or recognition) could be manipulated in a single experiment. The hypothesis would predict that elaborative and standard instructions would be equally effective for elderly subjects in both recall and recognition tests. Organization instructions should be associated with the highest level of recall for this age group, but a low level of recognition.

Another method of assessing older subject's ability to use effective encoding strategies is to manipulate test instructions. Young subjects differentially encode material in anticipation of a recall or recognition test (Tversky, 1973). If older subjects are also capable of adapting to the situation and selecting the most appropriate processing strategy, then their retention scores should reflect changes in strategy when a recall or recognition test is announced.

Previous research comparing the effects of orienting tasks in different age groups has been inconclusive. In a completely within-subjects design, White and Craik (in Craik, 1977) found a substantial age decrement in recognition following instructions to learn, but no age difference following a semantic orienting task. Type of task and method of test were between-subjects variables in the present investigation and the results were diamtrically opposed to the findings of White and Craik. In the present study there were large age differences in recognition in the category condition but there was no significant difference between young and old subjects in the standard condition. It would be of value to conduct a within-subjects study using the stimulus materials, task conditions, and test conditions of the present experiment.

Smith and Winograd (1976) used a between-subjects design to compare the effects of orienting tasks on memory for faces in different age groups. They found an improvement in the recognition scores of both young and old subjects following judgements of pleasantness. In the present experiment there was no significant improvement in the recognition scores of older subjects in the category task condition. There are two relevant methodological differences between the Smith and Winograd study and the present study, the type of stimuli (faces vs. words) and the type of orienting task (judging pleasantness vs. answering category questions). The relative importance of these two variables can only be determined in an experiment where type of stimulus and type of orienting task are manipulated independently.

APPENDIX A

STIMULUS MATERIALS

WORDS AND QUESTIONS*

Word	Rhyme	Category question	Word	Rhyme	Category question
SPEECH	each	a form of communication	BEAR	hair	a wild animal
BRUSH	lush	used for cleaning	LAMP	camp	a type of furniture
CHEEK	teak	a part of the body	CHERRY	very	a type of fruit
FENCE	tense	found in the garden	ROCK	stock	a type of mineral
FLAME	claim	something hot	EARL	pearl	a type of nobility
FLOUR	sour	used for cooking	POOL	school	a type of game
HONEY	funny	a type of food	WEEK	peak	a division of time
KNIFE	wife	a type of weapon	BOAT	rote	a mode of travel
SHEEP	leap	a type of farm animal	PAIL	whale	a type of container
COPPER	stopper	a type of metal	TROUT	bout	a type of fish
GLOVE	shove	something to wear	GRAM	tram	a type of measurement
MONK	trunk	a type of clergy	WOOL	pull	a type of material
DAISY	crazy	a type of flower	CLIP	ship	a type of office supply
MINER	liner	a type of occupation	JUICE	noose	a type of beverage
CART	start	a type of vehicle	POND	wand	a body of water
CLOVE	rove	a type of herb	LANE	pain	a type of thoroughfare
ROBBER	clobber	a type of criminal	NURSE	curse	associated with medicine
MAST	past	a part of a ship	LARK	park	a type of bird
FIDDLE	riddle	a musical instrument	STATE	crate	a territorial unit
CHAPEL	grapple	a type of building	SOAP	rope	a type of toiletry
SONNET	bonnet	a written form of art	JADE	raid	a type of precious stone
WITCH	rich	associated with magic	SLEET	feet	a type of weather
ROACH	coach	a type of insect	RICE	dice	a type of grain
BRAKE	shake	a part of a car	TIRE	fire	a round object
TWIG	big	a part of a tree	CHILD	wild	a human being
GRIN	bin	a human expression	DANCE	stance	a type of physical activity
DRILL	till	a type of implement	FIELD	shield	found in the countryside
MOAN	prone	a human sound	FLOOR	sore	a part of a room
CLAW	raw	a part of an animal	GLASS	pass	a type of utensil
SINGER	ringer	a type of entertainer	TRIBE	scribe	a group of people

*Stimulus materials used by Craik and Tulving (1975)

APPENDIX B

SAMPLE RECOGNITION TEST

RATTLE	YES	NO	FLOUR	YES	NO
MINER	YES	NO	suburb	YES	NO
VOICE	YES	NO	island	YES	NO
perch	YES	NO	AUNT	YES	NO
kettle	YES	NO	LEASH	YES	NO
fence	YES	NO	claw	YES	NO
BARLEY	YES	NO	FIELD	YES	NO
OVEN	YES	NO	WIDTH	YES	NO
typist	YES	NO	smock	YES	NO
pond	YES	NO	mast	YES	NO
FORK	YES	NO	MANE	YES	NO
cattle	YES	NO	beer	YES	NO
supper	YES	NO	lark	YES	NO
elbow	YES	NO	grocer	YES	NO
SHEEP	YES	NO	SNEEZE	YES	NO
state	YES	NO	BEAR	YES	NO
MURAL	YES	NO	LEAF	YES	NO
RULER	YES	NO	dial	YES	NO
aisle	YES	NO	brush	YES	NO
PASTE	YES	NO	thread	YES	NO
singer	YES	NO	saucer	YES	NO
WITCH	YES	NO	ACORN	YES	NO
train	YES	NO	sonnet	YES	NO
match	YES	NO	lamp	YES	NO
DEMON	YES	NO	MOTH	YES	NO

prune	YES	NO	yard	YES	NO
week	YES	NO	HOCKEY	YES	NO
WRITER	YES	NO	COPPER	YES	NO
sleet	YES	NO	target	YES	NO
riddle	YES	NO	iris	YES	NO
ballad	YES	NO	SYMBOL	YES	NO
DANCE	YES	NO	icing	YES	NO
POSTER	YES	NO	GRIN	YES	NO
wall	YES	NO	nurse	YES	NO
SWORD	YES	NO	cable	YES	NO
KILLER	YES	NO	PECAN	YES	NO
FIDDLE	YES	NO	DAISY	YES	NO
BIRCH	YES	NO	DITCH	YES	NO
tire	YES	NO	SCALE	YES	NO
relic	YES	NO	value	YES	NO
elves	YES	NO	CHAPEL	YES	NO
jade	YES	NO	prince	YES	NO
mirror	YES	NO	cavern	YES	NO
TOPAZ	YES	NO	NECTAR	YES	NO
MEDAL	YES	NO	TOWER	YES	NO
roach	YES	NO	EARL	YES	NO
MONK	YES	NO	howl	YES	NO
arch	YES	NO	SOAP	YES	NO
LIZARD	YES	NO	decade	YES	NO
STOOL	YES	NO	CLIP	YES	NO

carbon	YES	NO	SAND	YES	NO
trout	YES	NO	verb	YES	NO
nation	YES	NO	plot	YES	NO
floor	YES	NO	SPEECH	YES	NO
STOVE	YES	NO	SHEET	YES	NO
brake	YES	NO	ALLEY	YES	NO
lens	YES	NO	glove	YES	NO
DRAWER	YES	NO	lyric	YES	NO
JUICE	YES	NO	QUARRY	YES	NO
arrow	YES	NO	WINTER	YES	NO
ocean	YES	NO	ANKLE	YES	NO
clove	YES	NO	ROCK	YES	NO
CHERRY	YES	NO	JEWEL	YES	NO
REGION	YES	NO	sphere	YES	NO
bark	YES	NO	campus	YES	NO
TWIG	YES	NO	wool	YES	NO
taxi	YES	NO	MUSLIN	YES	NO
FERN	YES	NO	CHILD	YES	NO
ERROR	YES	NO	purse	YES	NO
PAIL	YES	NO	flame	YES	NO
handle	YES	NO	zone	YES	NO
TEMPLE	YES	NO	PROSE	YES	NO
TROOP	YES	NO	test	YES	NO
knife	YES	NO	robber	YES	NO
globe	YES	NO	tribe	YES	NO

ADULT	YES	NO	SEESAW	YES	NO
LANE	YES	NO	bacon	YES	NO
PIANO	YES	NO	GLASS	YES	NO
POOL	YES	NO	PRIEST	YES	NO
locket	YES	NO	cart	YES	NO
DANCER	YES	NO	TIGER	YES	NO
fabric	YES	NO	ORBIT	YES	NO
cheek	YES	NO	hoof	YES	NO
studio	YES	NO	clang	YES	NO
WHEAT	YES	NO	DRILL	YES	NO
RICE	YES	NO	gram	YES	NO
PILOT	YES	NO	FERN	YES	NO
HONEY	YES	NO	turnip	YES	NO
BOAT	YES	NO	NOVEL	YES	NO
RIOT	YES	NO	moan	YES	NO

APPENDIX C

TASK INSTRUCTIONS

STANDARD INSTRUCTIONS

Please do not turn this page until you are instructed to do so. Read these instructions carefully. Do not be concerned with what your neighbor is doing; you all have different tasks to perform. If you have any questions please raise your hand and one of us will help you.

This is an experiment on memory for words. We will show you 60 different words, then we will give you a memory test. While the words are being presented we would like you to check them off on your answer sheet. When the first word is shown place a check mark beside the number one on the answer sheet; when the second word is shown place a check mark beside the number two; and so on. Do this for each word.

We will show you the words for 5 seconds each. During each 5-second period you will study the word and place a check mark beside the appropriate number on your answer sheet. After all of the words have been presented you will be given a memory test.

Again, if you have any questions please raise your hand. If not, look up to indicate that you are ready to begin. Further instructions will be given when everyone is ready.

CASE INSTRUCTIONS

Please do not turn this page until you are instructed to do so. Read these instructions carefully. Do not be concerned with what your neighbor is doing; you all have different tasks to perform. If you have any questions please raise your hand and one of us will help you.

This is an experiment on memory for words. We will show you 60 different words, then we will give you a memory test. While the words are being presented we would like you to answer a series of questions. There are 60 questions printed in your answer booklet. As each word is presented on the screen you are to study the word, read the corresponding question, and answer the question by marking your answer sheet appropriately. For example, suppose the first word were DIME. If the first question in your answer booklet asked "Is the word in capital letters?" then you would circle the "YES" following the question. If the first question asked "Is the word in small letters?" then you would circle the "NO". Make your decisions quickly.

We will show you the words for 5 seconds each. During each 5-second period you will study the word, read the corresponding question, and answer the question by circling the "YES" or "NO" on your answer sheet. After all of the words have been presented you will be given a memory test.

Again, if you have any questions please raise your hand. If not, look up to indicate that you are ready to begin. Further instructions will be given when everyone is ready.

RHYME INSTRUCTIONS

Please do not turn this page until you are instructed to do so. Read these instructions carefully. Do not be concerned with what your neighbor is doing; you all have different tasks to perform. If you have any questions please raise your hand and one of us will help you.

This is an experiment on memory for words. We will show you 60 different words, then we will give you a memory test. While the words are being presented we would like you to answer a series of questions. There are 60 questions printed in your answer booklet. As each word is presented on the screen you are to study the word, read the corresponding question, and answer the question by marking your answer sheet appropriately. For example, suppose the first word were DIME. If the first question in your answer booklet asked "Does the word rhyme with LIME?" then you would circle the "YES" following the question. If the first question asked "Does the word rhyme with TABLE?" then you would circle the "NO". Make your decisions quickly.

We will show you the words for 5 seconds each. During each 5-second period you will study the word, read the corresponding question, and answer the question by circling the "YES" or "NO" on your answer sheet. After all of the words have been presented you will be given a memory test.

Again, if you have any questions please raise your hand. If not, look up to indicate that you are ready to begin. Further instructions will be given when everyone is ready.

CATEGORY INSTRUCTIONS

Please do not turn this page until you are instructed to do so. Read these instructions carefully. Do not be concerned with what your neighbor is doing; you all have different tasks to perform. If you have any questions please raise your hand and one of us will help you.

This is an experiment on memory for words. We will show you 60 different words, then we will give you a memory test. While the words are being presented we would like you to answer a series of questions. There are 60 questions printed in your answer booklet. As each word is presented on the screen you are to study the word, read the corresponding question, and answer the question by marking your answer sheet appropriately. For example, suppose the first word were DIME. If the first question in your answer booklet asked "Is the word a type of money?" then you would circle the "YES" following the question. If the first question asked "Is the word a type of fruit?" then you would circle the "NO". Make your decisions quickly.

We will show you the words for 5 second each. During each 5-second period you will study the word, read the corresponding question, and answer the question by circling the "YES" or "NO" on your answer sheet. After all of the words have been presented you will be given a memory test.

Again, if you have any questions please raise your hand. If not, look up to indicate that you are ready to begin. Further instructions will be given when everyone is ready.

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